

## Effect of precautionary and normalization steps on course of COVID-19 pandemic in Turkey

Course of COVID-19 pandemic in Turkey

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### Abstract

**Aim:** The COVID-19 pandemic began in China and has now spread across the whole world, and many countries such as Turkey are still fighting against this pandemic. The aim of this study was to investigate the impact of precautionary and normalization steps taken by the Turkish government on the number of confirmed cases, current cases, and deaths due to the COVID-19 in Turkey.

**Materials and Methods:** The study used exponential regression models to estimate the number of confirmed cases, deaths, and current cases. The study data were collected from the Turkish Ministry of Health, Turkish Ministry of Internal Affairs, and the national public broadcaster of Turkey.

**Results:** The precautions taken during the COVID-19 pandemic have caused the exponentially increasing number of cases to be brought under control and to decrease exponentially. The normalization steps taken paused the exponential decrease in the number of cases and caused the number of cases to remain flat during the summer months and then rise again. If the normalization steps were not implemented and the precautions taken continued in the same way, it was calculated that the numbers of COVID-19 current cases would be reset on June 26, 2020. The total number of deaths would remain at 4423 and the total number of confirmed cases would be 150586.

**Discussion:** As a result, the impact of precautionary and normalization steps on the course of the COVID-19 pandemic was examined. It has been observed that the impact of these steps on the pandemic is exponential. The results provide guidelines for health authorities and administrators to take necessary precautions.

### Keywords

COVID-19 pandemic; Turkey; Case estimation; Precautions; Normalization steps

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## Introduction

Contagious diseases threatening a large number of people simultaneously in the world are called a pandemic. According to the World Health Organization's (WHO) definition, three criteria are sought for a disease to become a pandemic (available at: [https://www.who.int/csr/disease/swineflu/frequently\\_asked\\_questions/pandemic/en/](https://www.who.int/csr/disease/swineflu/frequently_asked_questions/pandemic/en/)). It is a new virus; it can be spread worldwide; most people's immunity cannot resist it.

Cases of pneumonia of unknown etiology detected in Wuhan City, Hubei Province of China were reported by the WHO China Country Office on December 31, 2019 (available at: <https://www.who.int/csr/don/05-january-2020-pneumonia-of-unknown-cause-china/en/>). On January 7, 2020, the causative agent is identified as a new coronavirus (2019-nCoV), which has not previously been detected in humans (available at: [https://covid19bilgi.saglik.gov.tr/depo/rehberler/COVID-19\\_Rehberi.pdf](https://covid19bilgi.saglik.gov.tr/depo/rehberler/COVID-19_Rehberi.pdf)). Later, the name of the 2019-nCoV disease was accepted as COVID-19, and the virus was named as SARS-CoV-2 because of its close resemblance to SARS CoV (available at: [https://covid19bilgi.saglik.gov.tr/depo/rehberler/COVID-19\\_Rehberi.pdf](https://covid19bilgi.saglik.gov.tr/depo/rehberler/COVID-19_Rehberi.pdf)). Since the emergence of the COVID-19 pandemic, it has rapidly spread across China and many other countries and has become a major global health concern. The disease has spread rapidly due to its ability to spread from person to person [1].

The WHO has started publishing situation reports on the latest data and information on COVID-19 (available at: <https://covid19.who.int/table>). According to these reports, globally, as of October 31, 2020, the total number of confirmed cases of COVID-19 has reached approximately 43 million including 1.15 million deaths. The top 10 countries with the highest number of cases and deaths were the USA, India, Brazil, Russia, France, Argentina, Spain, Colombia, Mexico, and Peru, respectively. Although China was the country where the pandemic was first seen, it has managed to reduce the number of cases with the precautions it has taken and dropped from first place to fiftieth. Since the necessary precautions were not taken in time, the speed of cases and deaths in Italy and Spain increased so quickly that the health system collapsed. Now, a similar situation may be in question for the USA, India, and Russia. In these countries, the situation is gradually getting worse, and the number of confirmed cases and deaths continues to dangerously fluctuate. By the end of October, the number of confirmed cases (deaths) in the first three countries was approximately 8.5 million (83 thousand), 8.0 million (45 thousand), and 5.0 million (27 thousand), respectively.

In Turkey, the first COVID-19 case was detected on the 11th March 2020 with the first death taking place on the 17th March 2020 (available at: [https://covid19.saglik.gov.tr/?\\_Dil=2](https://covid19.saglik.gov.tr/?_Dil=2)). The number of confirmed cases and deaths in Turkey was increasing rapidly, and it took twenty-first place in terms of the number of cases and deaths in the world (available at: <https://covid19.who.int/table>). As of October 31, 2020, approximately 360 thousand confirmed cases and 10 thousand deaths were identified (available at: [https://covid19.saglik.gov.tr/?\\_Dil=2](https://covid19.saglik.gov.tr/?_Dil=2)). The government of the Republic of Turkey and the Ministry of Health (MoH) established the first COVID-19 pandemic center on January 6, 2020 to combat the COVID-19 pandemic when it first appeared in China, and established the Scientific

Committee on January 10. On February 5, all flights from China were stopped. The first case was announced on March 11, and education was interrupted at all schools on March 12. The first death occurred on March 17. Afterwards, prohibitions for the population over 65 and under 20, and in major cities prohibitions on holidays and weekends are declared. In the fight against COVID-19, the government continues to strictly fulfill its obligations.

The Turkish Statistical Institute has announced Turkey's population as 83 million by the end of 2019 and 9.1% of Turkey's population constitute elderly population over 65 years of age (available at: <http://www.turkstat.gov.tr/Start.do>). Turkey is a country with a young population compared to other western countries. Considering that COVID-19 targets the elderly and chronic patients, Turkey has an important advantage in combating pandemic. A health care reform that lasted from 2002 to 2012 in Turkey is concerned. As a result of the reform process, which is also exemplified by the WHO, the Turkish health system has strengthened and significantly increased its healthcare capacity (available at: [www.sourceoecd.org/socialissues/9789264051089](http://www.sourceoecd.org/socialissues/9789264051089)).

The Turkish government has taken normalization steps for returning to the normal daily life of its citizens after taking the necessary precautionary steps to ensure control of the spread of the COVID-19 pandemic. The aim of this study was to investigate the impact of the precautionary and normalization steps taken by the Turkish government on the course of the COVID-19 pandemic in Turkey. The study planned to show the impact of these steps on the number of confirmed cases, current cases, and deaths due to the COVID-19. For this purpose, the study seeks answers to the following two main research questions:

Question 1: How have the precautionary and normalization steps affected the number of current cases of COVID-19 in Turkey?

Question 2: What would happen if precautions are continued in the fight against the COVID-19 pandemic in Turkey?

## Material and Methods

### Data sources

The study used two types of data to carry out research. The first data were related to the precautionary and normalization steps taken by the Turkish government during the COVID-19 pandemic. The related data were obtained from the Turkish Ministry of Internal Affairs (available at: <https://www.icisleri.gov.tr/>) and TRT HABER website that is the national public broadcaster of Turkey (available at: <https://www.trthaber.com/haber/turkiye/turkiyenin-koronaviruse-karsi-gun-gun-attigi-adimlar-477903.html>).

Another data were related to the number of confirmed cases, recovered cases, and deaths due to the COVID-19 in Turkey. The data were collected from the information web page of the Turkish Ministry of Health COVID-19 (available at: [https://covid19.saglik.gov.tr/?\\_Dil=2](https://covid19.saglik.gov.tr/?_Dil=2)). In addition, the number of current cases was obtained by subtracting the total number of recovered cases and deaths from the total number of confirmed cases. While creating the data set, the number of confirmed cases, deaths, recovered cases, and current cases were collected on a

daily basis between 01 April 2020 and 10 May 2020.

**Statistical model**

The study used a regression analysis technique to estimate the number of confirmed cases, deaths, and current cases. The regression analysis is a kind of modeling technique, which is used in the prediction of the dependent variable, based on the relationship between the dependent (predicted) and independent (predictor) variables [2]. The time-dependent change (spreading) rate of the COVID-19 pandemic varies exponentially [3,4]. Therefore, the study preferred exponential regression models to estimate the number of confirmed cases, deaths, and current cases. The analysis of the data to be used in the regression models was performed using Curve Fitting Toolbox™ in MATLAB R2015b (The MathWorks Inc., Natick, Massachusetts, USA) software program.

**Results**

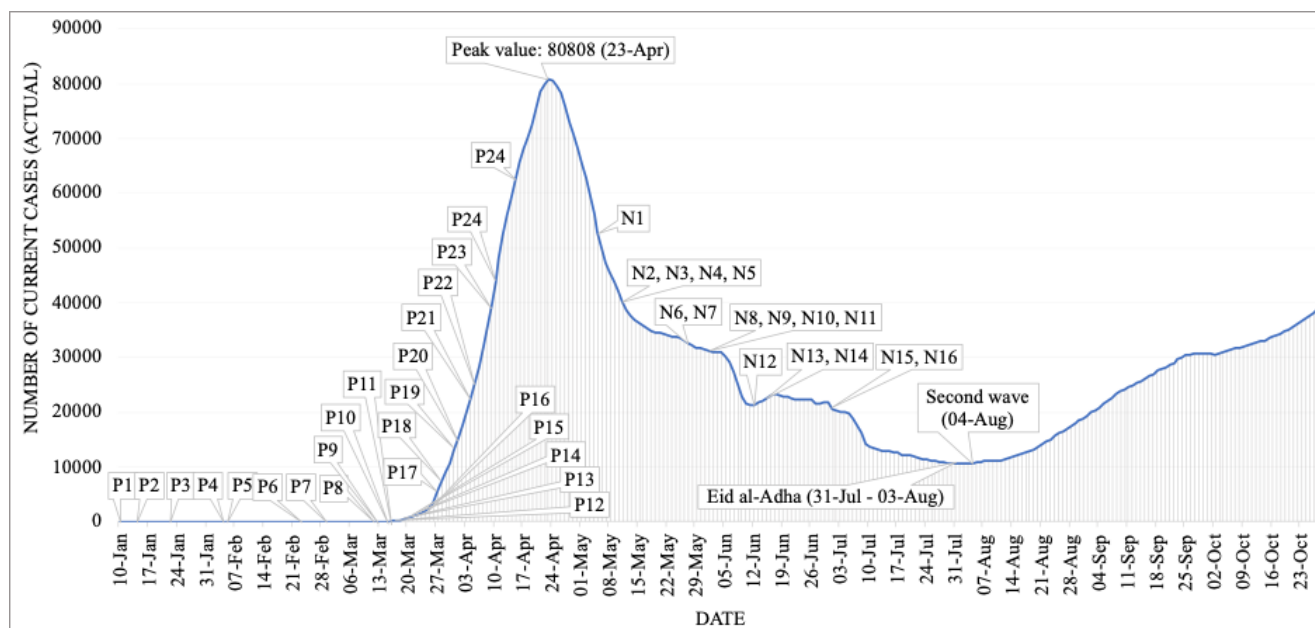
Public authorities in Turkey, like other countries in the region, have taken many precautions to ensure social isolation to fight the COVID-19 epidemic. When the epidemic was brought under control, and the number of cases decreased to a certain level, normalization steps were taken by spreading over time to control the normalization of social life. Thus, by reducing the level of social isolation, it has been tried to normalize life under new conditions. The precautions taken against the COVID-19 pandemic and the chronology of the subsequent normalization practices in Turkey are presented in Table 1. The matching of the implementation dates of the precautions and normalizations in the table with the current case process is shown in Figure 1. At the same time, Figure 1 enables monitoring of the effect of the precaution and normalization applications on the number of current cases.

In Turkey, public authorities have closely monitored the COVID-19 pandemic in China, and precaution packages have been put into practice as of January 10, 2020, considering that the disease will spread to our country. As the pandemic reached Europe and Turkey, attempts were made to prevent the spread of the disease, and the number of cases and deaths

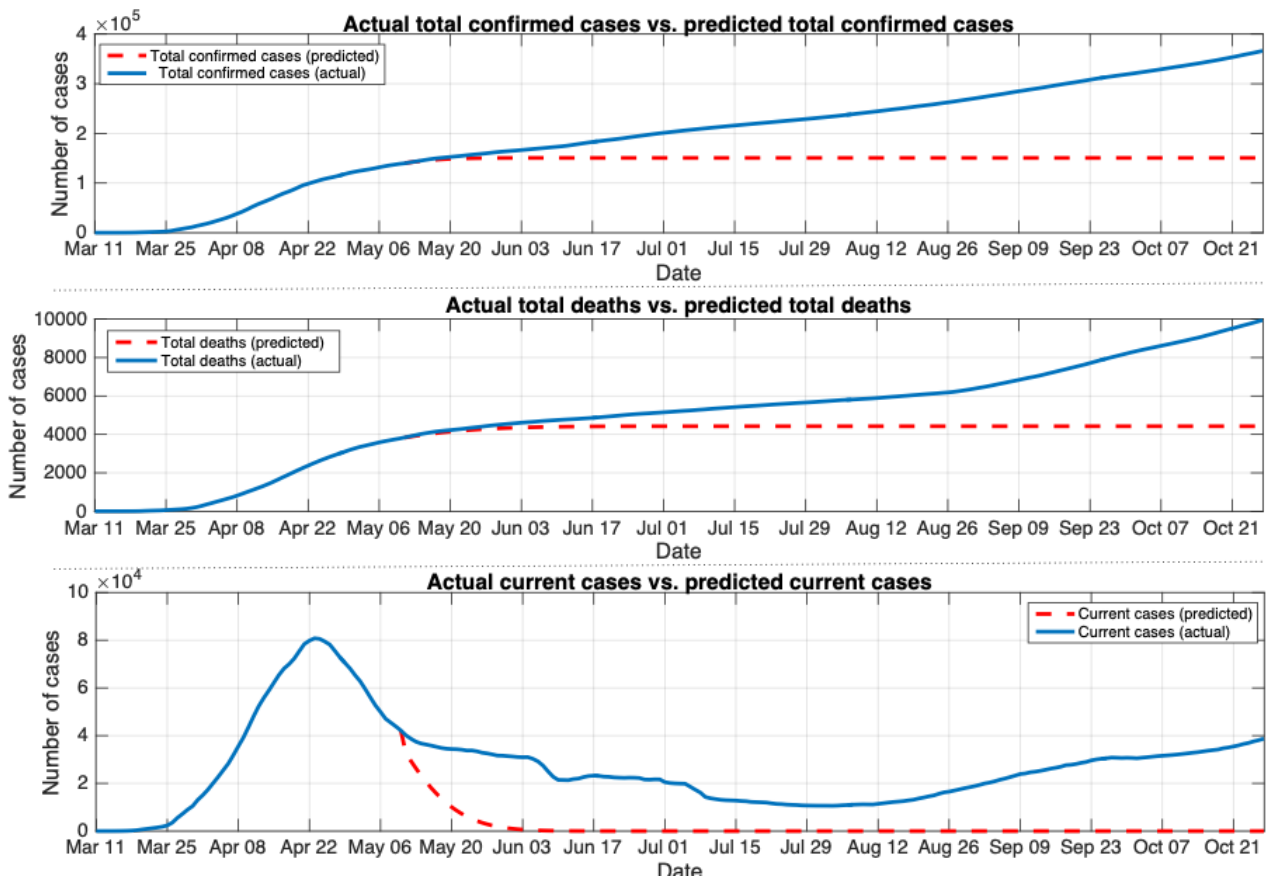
could be controlled with precautions such as school holidays, travel restrictions, curfews. COVID-19 cases since March 11 in Turkey have begun to increase exponentially. With tighter social isolation precautions, in line with the increase in cases, the increase in the number of cases slowed down and the epidemic peaked on April 23. As of April 23, the number of cases has dropped exponentially under the influence of the precautions. The public authorities aimed to reduce the problems that society and the economy face due to social isolation, and at the same time, to keep the disease under control. The public authorities have started to take normalization steps since 11 May. The normalization steps slowed down the exponential decline in the cases, and the graph started to move horizontally. Since the effect of normalization steps on the number of cases was within the minimum incubation period of the disease of 4-5 days, the differentiation started to be reflected in the number of cases and deaths as of May 15.

The answer to the first question that the research is trying to answer can be summarized as follows: as seen in Figure 1, the precautions taken by the government ensured that the number of current cases, which increased exponentially, peaked on April 23, 2020 and decreased exponentially until May 15, 2020. With the normalization steps, the exponential decrease in the number of current cases has stopped. The number of current cases continued to decline horizontally and fluctuate until August 4, and since then the second rising trend has started.

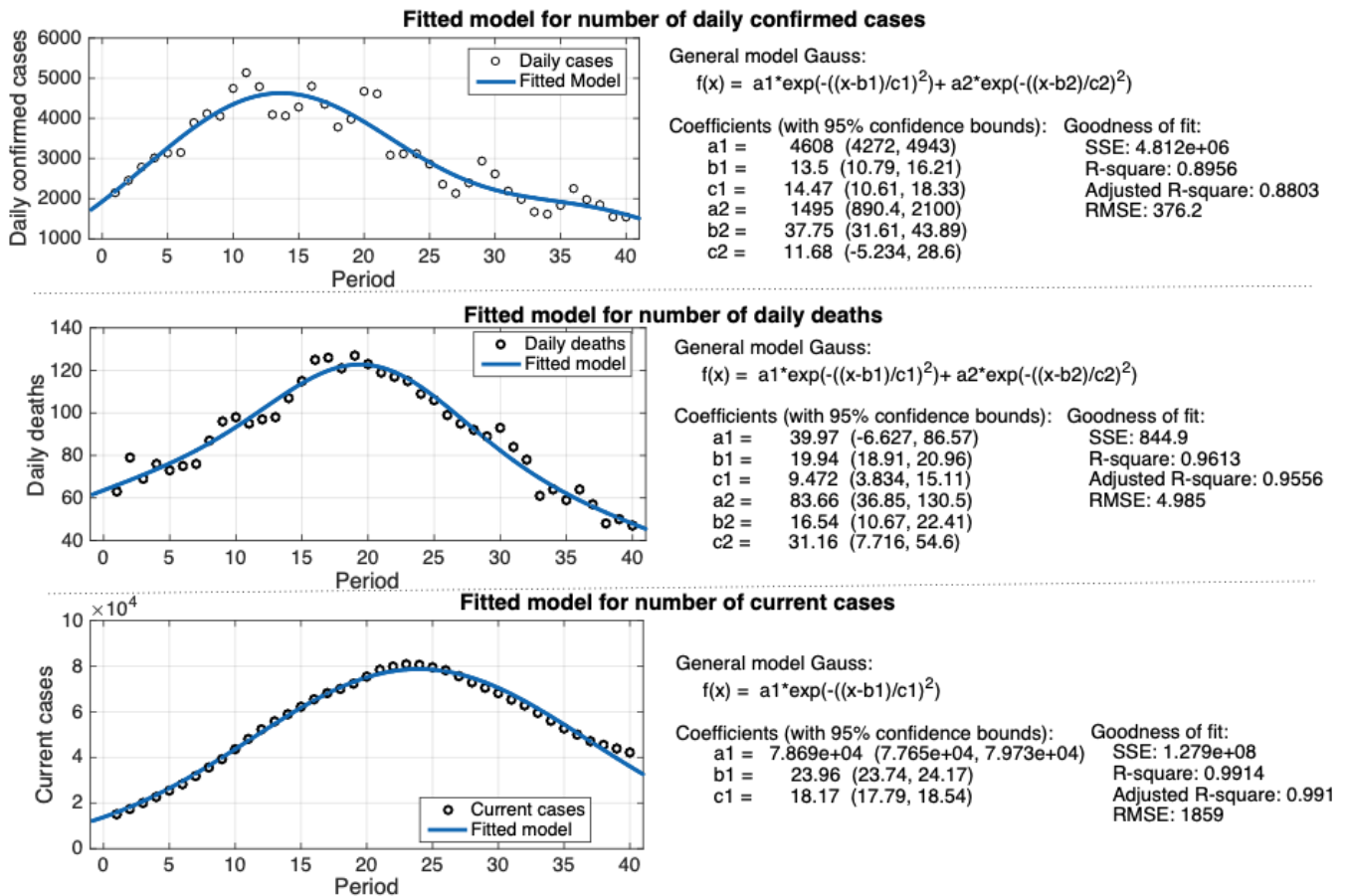
The study used the regression analysis technique to answer the other main question of the study: “What would happen if precautions continued in the fight against the COVID-19 pandemic in Turkey?” The coefficients of the regression models and their fitting scores are shown in Figure 2. According to the figure, the values of R-squared (with a 95% confidence bounds) ranged from 0.90 to 0.99 for all models. Table 2 contains actual data and estimation data obtained using regression models. A comparison of the two data, including the number of confirmed cases, current cases, and deaths due to the COVID-19 is given in Figure 3.



**Figure 1.** The course of current cases with precautionary and normalization steps



**Figure 2.** Comparison of the numbers of the actual cases and predicted cases.



**Figure 3.** The results of regression models according to the type of COVID-19 case.

When examining Table 2 according to the predictive model developed in the study, if normalization steps had not been taken and the current social isolation precautions continued, the number of current cases would have been reset on June 26, 2020. The total number of deaths would remain at 4423, and 642 people could be prevented from dying due to COVID-19. Thus, by keeping the total number of confirmed cases at 150586, 43925 people would have been prevented from having COVID-19 (Figure 3). After 16 normalization steps taken between May 5 and July 1,

the number of current cases decreased to 10647 at the end of July. After the holiday of Eid al-Adha, which is celebrated between July 31 and August 3, the number of COVID-19 cases has increased again since August 4.

The increase in the number of cases and deaths, which started on August 4, continues as of October 27, 2020, when the study was conducted. As of this date, the total number of confirmed cases was 366208; the number of current cases is 38739; the total number of deaths was 9950. If, according to the prediction model, it is assumed that the number of COVID-19 cases was

**Table 1.** COVID-19 precaution and normalization steps taken by the Turkish government

Code	Date	Precautionary steps
P1	10-Jan	Ministry of Health established the Coronavirus Scientific Board
P2	14-Jan	The first guide about the disease was prepared
P3	22-Jan	Flights from Wuhan, where the virus originated in China, to Istanbul were stopped
P4	04-Feb	Fever measurements started with thermal cameras at airports
P5	05-Feb	All flights from China were stopped
P6	23-Feb	Land borders between Turkey and Iran were closed
P7	29-Feb	All passenger traffic with Italy, South Korea, and Iraq stopped
P8	12-Mar	Schools were closed
P9	13-Mar	Public events were restricted
P10	15-Mar	Extensive travel and transportation restrictions have been imposed. Collective venues were temporarily closed
P11	16-Mar	Mass worships were suspended. It was decided to postpone non-urgent surgeries and dental practices
P12	17-Mar	The number of countries whose flights were suspended increased to 20
P13	19-Mar	Football, basketball, handball, and volleyball leagues have been postponed. The number of centers where COVID-19 tests were carried out was increased to 18
P14	21-Mar	Citizens aged 65 and over and those with chronic illnesses were banned from leaving their residences. The number of centers conducting COVID-19 tests increased to 73 in 44 provinces. The number of countries that suspended the flight was 68. The services were restricted to take-away services by banning customers from sitting in the food service establishments
P15	22-Mar	Flexible work started in the public sector
P16	24-Mar	The capacity of public transport has been reduced to 50 percent. The rule of social distance between passengers was introduced
P17	27-Mar	The sale of materials that are not essential in the market places is prohibited. A distance of 3 meters was brought between the benches
P18	28-Mar	Intercity bus and plane travels were subject to permission. International flights were stopped
P19	31-Mar	The number of centers performing COVID-19 tests increased to 75
P20	01-Apr	It was decided to inspect the entrance and exit to the market places
P21	04-Apr	Curfews were imposed for those under the age of 20. The entry and exit ban has started in 30 metropolitan cities. It is banned to be unmasked in collective places, markets, and markets
P22	05-Apr	Free mask distribution started
P23	09-Apr	It was decided to collect the masks and gloves in a separate waste bin and hand them over to the municipal teams after 72 hours
P24	10-Apr, 15-Apr	Curfew restrictions were made to 30 metropolitan cities for the weekend
Code	Date	Normalization steps
N1	05-May	In transportation and public transportation, the single, double limitation for commercial taxis in Istanbul, Ankara and Izmir was lifted
N2	11-May	The barbershop, beauty salon/center, hairdresser and similar places were opened with an appointment system in compliance with the necessary hygiene conditions and with half the number of seats at the same time (mask, overalls, gloves)
N3	11-May	The shopping malls were opened on the condition that general and special rules (ministry of trade, ministry of health and ministry of interior) are followed
N4	11-May	Markets and outlets where clothing, bags, ornaments and glassware and similar products are sold were allowed to operate on the condition that general and special rules (ministry of commerce, ministry of health and ministry of interior) are followed
N5	11-May	Restaurants, cafes, patisseries and similar workplaces were allowed to open on the condition that general and special rules (ministry of commerce, ministry of health and ministry of interior) are followed
N6	27-May	The age restriction for citizens aged 65 and over and under 20 has been completely lifted
N7	27-May	Restrictions on entry and exit between cities were lifted for 13 provinces
N8	01-Jun	Curfews were lifted on weekends
N9	01-Jun	It was allowed to open facilities such as public recreation and entertainment places, tea gardens, association clubs, swimming pool, spa and sports centers
N10	01-Jun	The ruins are opened
N11	01-Jun	The wedding halls were allowed to be opened gradually, complying with the conditions of not exceeding the maximum capacity of 25%
N12	12-Jun	Mass worship began to be performed in mosques and masjids, which are deemed appropriate, provided that physical distance is maintained and masks are used
N13	15-Jun	The recreation areas and picnic areas were opened
N14	15-Jun	Border gates with countries where the epidemic was taken under control were opened for passenger entry and exit
N15	01-Jul	Restrictions were lifted in wedding halls, cinemas, theaters and performance centers
N16	01-Jul	Special education and rehabilitation centers started operations

**Table 2.** Comparison matrix of the number of actual cases and predicted cases by date

		15-May	31-May	26-Jun*	30-Jun	31-Jul	04-Aug**	31-Aug	30-Sep	27-Oct
Total cases	Actual	146457	163942	194511	199906	230873	234934	270133	318663	366208
	Predicted	145098	150524	150586	150586	150586	150586	150586	150586	150586
	Difference	1359	13418	43925	49320	80287	84348	119547	168077	215622
	Difference (%)	0.9	8.2	22.6	24.7	34.8	35.9	44.3	52.7	58.9
Total deaths	Actual	4055	4540	5065	5131	5691	5765	6370	8195	9950
	Predicted	3990	4331	4423	4424	4424	4424	4424	4424	4424
	Difference	65	209	642	707	1267	1341	1946	3771	5526
	Difference (%)	1.6	4.6	12.7	13.8	22.3	23.3	30.6	46.0	55.5
Current cases	Actual	36269	31429	22248	21664	10647	10678	18837	30719	38739
	Predicted	20570	1231	0	0	0	0	0	0	0
	Difference	15699	30198	22248	21664	10647	10678	18837	30719	38739
	Difference (%)	43.3	96.1	100.0	100.0	100.0	100.0	100.0	100.0	100.0

\*: The end date for current cases, if the precautions are not relaxed. \*\*: The initial date of the second wave.

zero on June 26, and then there will be no COVID-19 cases again, it can be claimed that 215622 people can be prevented from having COVID-19 and 5526 people can be prevented from dying from COVID-19.

According to the findings of the research, the answer to the second question of the research is as follows: if the normalization steps were not taken as of the beginning of May and the precautions continued, the number of current cases would have dropped on June 26, 2020. Also, the number of deaths could remain at 4423, while the total number of confirmed cases could account for 150586.

**Discussion**

In this study, the impact of the precautionary and normalization steps taken by the Turkish government on the number of confirmed cases, current cases, and deaths due to the COVID-19 in Turkey was researched. The study collected two types of data to perform the analysis. In addition, exponential regression models were used to estimate the number of cases of the COVID-19 pandemic. The analysis indicated that the impact of precautionary and normalization steps on the course of the COVID-19 pandemic was exponential.

The rate at which COVID-19 will spread will vary according to demographic, epidemiological, and socioeconomic factors because such factors of society such as education, culture, customs and traditions will play a big role in combating the pandemic [5]. In societies with strong family ties, such as Turkey, it is difficult to enforce social isolation or enforce rules. For example, immediately after the holiday of Eid al-Adha, the number of cases increased rapidly.

Another reason for the increase in the number of cases in Turkey could also be hosting a significant number of refugees. In Turkey, in particular, there are approximately 4 million refugees and asylum seekers, most of whom are refugees escaping from the civil war in Syria (available at: <https://www.unhcr.org/tr/unhcr-turkiye-istatistikleri>). Such vulnerable groups often live together and in the near abroad. In addition, such low-income groups have limited access to health resources and personal protective equipment. Therefore, these groups cause a high mortality rate and a greater epidemic impact [5].

On the other hand, the findings on the number of COVID-19

cases regarding behavior change are similar to the studies in different countries. Ismail et al. [6] tried to predict the course of COVID-19 in 187 countries using time series. As a result of the study, the number of cases in some countries showed an exponential, and in some countries, showed an exponential + linear behavior. Komarova et al. [7] conducted a study examining the spread behavior of COVID-19 for 174 countries, similar to the previous study. When the findings of the study were examined, it was observed that the number of cases displayed exponential behavior in the early stages of the pandemic, while the number of cases displayed power-law behavior in the advanced stages of the pandemic.

The study examined the course of the COVID-19 epidemic in Turkey according to the precautions taken and in terms of normalization steps. The event was viewed from the perspective of fighting the COVID-19 pandemic. Public authorities first took precautions to increase social isolation to fight the disease. When they believed that the epidemic had been taken under reasonable control, they took normalization steps to meet the social and economic needs of the society in a limited way. The precautions have enabled us to quickly and sharply control the pandemic. The normalization steps have led to horizontal fluctuations in the number of cases and deaths, and prevented the possibility of ending the COVID-19 epidemic in June. Thus, the COVID-19 pandemic was carried over to the fall season, causing an increase in the number of cases and deaths.

COVID-19 epidemic process in Turkey continues in a similar way in Europe and many other countries. Some countries, such as China, where the COVID-19 epidemic started, Japan and South Korea, declare that they reset the number of cases or keep them very little. If, Turkey had acted in decisive precautions, could Turkey reset the number of cases as predicted in this study? The answer to this question will always be curious.

**Scientific Responsibility Statement**

The authors declare that they are responsible for the article's scientific content including study design, data collection, analysis and interpretation, writing, some of the main line, or all of the preparation and scientific review of the contents and approval of the final version of the article.

**Animal and human rights statement**

All procedures performed in this study were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical

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**Conflict of interest**

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